PREDICTION OF GREY WATER FOOTPRINT BY USING ARTIFICIAL NEURAL NETWORK AND RANDOM FOREST

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Thesis submitted in fulfillment of the requirements
for the award of the
Bachelor Degree in Civil Engineering

Faculty of Civil Engineering and Earth Resources

UNIVERSITI MALAYSIA PAHANG

MAY 2019

ACKNOWLEDGEMENTS

Alhamdulillah, all praise and thanks belong to Allah alone because He is the originator of everything.

My deep gratitude goes first to Dr. Edriyana, who expertly guided me in completing my Final Year Project. Your guidance kept me constantly engaged with my research. Without her assistance and dedicated involvement in every step throughout the process, this thesis would have never been accomplished. I would like to thank you very much for your support and understanding over these past one year.

My appreciation also extend to my co-supervisor, Mr. Syazwan Nizam who monitoring all my progress, showing me the right way to do the best research and teach me new knowledge of water footprint. Not to forget my research members, Ainifatihah, Fazlina and Syazwan who cooperated and help each other in completing our research. Thank you for accompanying each other going through hardship of research study.

Most importantly, none of this could have happened without my family. My mother who offered her encouragement through phone calls every week. With their present and financial support, I am really grateful for my sisters Ruziah and Rubi. Above all, thank you again for those who I forget to mention.

ABSTRAK

Loji Rawatan Air (LRA) adalah satu tempat untuk merawat air mentah yang berasal dari bumi seperti sungai, tasik, laut dan air bawah tanah yang akan diagihkan untuk kegunaan masyarakat sekitar. Walaubagaimanapun, Loji Air di Malaysia masih lagi menggunakan proses rawatan air mentah konvensional. Oleh itu, jejak penggunaan air tiada dalam rekod catatan loji rawatan air. Dengan menggunakan pendekatan jejak air (Water Footprint Approach), jejak air kelabu (WFgrey) dinilai untuk mengukur kualiti air mentah. Jejak air (Water footprint) adalah penunjuk penggunaan air bersih yang mengira bukan sahaja air yang digunakan secara terus, tetapi juga air yang digunakn secara tidak terus. Disamping itu, jejak air kelabu (WFgrey) adalah jumlah air bersih yang diperlukan untuk mengasimilasi bahan tercemar di dalam air. Kajian ini fokus dalam mengira jejak air kelabu (WFgrey) di dua Loji Rawatan Air iaitu Loji Rawatan Air Semambu dan Panching. Tempoh yang dikaji bermula dari 2015 hhingga 2017. Terdapat beberapa faktor yang mempengaruhi pengiraan jejak air kelabu (WFgrey) seperti kandungan bahan tercemar didalam air mentah, kadar pelepasan air dan jumlah pengambilan air. Dalam kajian ini, peningkatan jumlah jejak air kelabu (WFgrey) adalah disebabkan oleh kandungan iron dan ammonia yang tinggi dalam sumber air yang kebanyakannya berasal dari perlombongan bauksit di Kuantan. Walaubagaimanapun, jumlah kesuluruhan jejak air kelabu (WFgrey) menunjukkan penurunan yang mana adalah menunjukkan petanda yang baik untuk keberlangsungan sungai. Sebagai rumusan, jumlah jejak air kelabu (WFgrey) dijangka akan menurun pada masa depan. Namun begitu, peluang untuk jejak air kelabu (WFgrey) untuk meningkat masih ada jika sungai tercemar. Kajian ini mencadangkan supaya aktiviti-aktiviti industri berdekatan sungai harus dijalankan mengikut prosedur operasi standard (SOP) dan kilang-kilang juga mesti membersihkan sisa-sisa tercemar terlebih dahulu sebelum dinyahkan ke sungai.

ABSTRACT

Water Treatment Plant (WTP) is a place to treat raw water from earth resources like river, lake, ocean and underground water which will supply to society. However, the water treatment plant in Malaysia still using conventional WTP to treat the raw water. So, the footprint of water usage is not yet in the recorded. By using water footprint (WF) approach, the grey water footprint (WFgrey) is assessed in order to evaluate the raw water quality. Water footprint is the indicator of freshwater use that looks not only at direct water use but also at indirect water use. Meanwhile, grey water footprint is the amount of freshwater needed to assimilate the pollutant. This study focused in calculating grey water footprint of two WTPs which is Semambu WTP and Panching WTP. The study period start from 2015 until 2017. There are factors influenced the calculation of total grey water footprint such as the concentration of pollutant considered, the discharge rate and the amount of water intake. In this study, the increment of total grey water footprint is due to high amount iron and ammonia in water intake which mostly come from bauxite mining in Kuantan. However, the overall grey water footprint trend shows decrement which is good sign for river sustainability. As a conclusion, the total grey water footprint is predicted to decrease in future. But, there is also chance for the grey water to increase if the river is polluted. This study suggested that the industrial activities near the river must be carried out with Standard Operation Procedure and the factory also must treated the effluent before discharge it into river.

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LIST OF SYMBOLS

BOD	Biological Oxygen Demand
COD	Chemical Oxygen Demand
Fe^{2}	Iron
L	Load of pollutant
NH_4	Ammonia

LIST OF ABBREVIATIONS

ANN	Artificial Neural Network
JPS	Jabatan Pengairan dan Saliran
MMD	Meteorological Department
MOH	Ministry of Health
PAIP	Random Forest
RF	Pengurusan Air Pahang Berhad
RMSE	Root Mean Square Error
WFgrey	Grey Water Footprint
WTP	Water Treatment Plant Malaysia

CHAPTER 1

INTRODUCTION

1.1 Introduction

Every living thing needs water to survive. No matter where, when and who. It is one of the basic things to continue living. However, people tend to forget about the importance of good quality water's availability when they are flooded with the clean water resource while the other side of the world is thirsting for a drop of clean water. This is a predictable human behaviour. In fact, changing human behaviour is harder than maintaining the water quality itself.

It is important to keep supplying good quality of water resources in a country, especially in a developing country which water demand is high. Apart from providing the daily need of living things for instances drinking, showering and cleaning, water supply also important in maintaining economic activities like agriculture, construction and industries. Plentiful water resources in a dam, lake or river are important to generate energy like electrical energy with lower cost.

Economic activities are production of goods and services which make them available to the consumers. It is human activities which are performed in exchange for money. Rapid economic activities are good in setting up a developing country. Nevertheless, in getting something big, there is price to pay behind it. Water consuming in rapid economic activities is high. This is a big problem for a developed country in maintaining their triumph with limited clean water resources. It is one of the reasons why the places with water scarcity is having problem in expanding their economic activities. For today, not only undeveloped country likes South Africa faces the problems, the developing country also facing the same problem due to water crisis. For instances, Brazil, China, London and Tokyo (Margrit, 2018).

Energy supply is providing the society with comfort to carry on daily life. The applications which can change water into energy are through hydroelectric power, ocean energy and saline water. Hydroelectric power and ocean energy can transform kinetic energy to electric energy. While saline water is an application that transform solar energy to heat and electricity energy (Srinivas, n.d.). Water is a cheap energy producing. However, lacking in water quantity and quality will result expensive charge later on in producing energy.

World population is growing from time to time. Urbanization has become a common thing nowadays and it is one of the causes of water crisis. Demand for good quality of water is high but, the good water availability is decreasing and people are still not aware about it. According to (Wu, Liu, & Chen, 2012), migration from rural area to the cities has resulted water crisis in China. Urbanization is a good process. Despite of that, more water is needed in making sure the prosperity of urbanization. In fact, water might not be existed in future if the society is not conscious about the right way in managing water consuming.

Water footprint is a tool to know the management and consumption of water supply which is used directly or indirectly. It is important for us to know the water cycle so that we can reduce wastage of water due to overuse of the earth resources in human activities.

1.2 Problem statement

Water treatment plant is a place to treat raw water from pollutants and toxins for the usage of society (Alaska Department of Environmental Conservation, 2015). Example of raw water that been treated by water treatment plants are ground water, surface water, ocean water and spring water. There are many stages the raw water should pass through so that the pollutant and toxin can be separated. The last stage of treated water than can be distributed to the end users.

The study is conducted at Panching and Semambu Water Treatment Plants. At the study area, there is large quantity of water which comes from Kuantan river basin. However, the management of the water treatment plants is not yet updated. There is no

overall water cycle recorded include rain and evaporation. It is hard for the researchers to track the water cycle due to incomplete data. Malaysia is an equatorial climate which got rain throughout the year. During dry season, the shortage of water results in low water flow and pressure. While during raining season, the rivers basin overflow and resulting flooded in some places. The water treatment plant management must be burdened by this matter because of uneven level of raw water resources in Kuantan river basin.

Currently, the water demand is increasing because of the growing population. It will keep increasing from time to time. It is important to keep track of the water cycle so that the water use can be managed. The awareness among the society also should be raised about the shortage of water supply in upcoming years.

Water footprint (WF) is functioned to upgrade and analyse the water use efficiency and water resources management (Lathuillière, Bulle, & Johnson, 2018). Water footprint generally breaks into three parts which are blue, green and grey water footprint. In this study, water footprint application is used to know the total grey water in Kuantan river basin which is supplied as raw water resources in Panching and Semambu water treatment plants. Grey water footprint is the water that polluted after it is used to produce some productions like the water use after the production of cotton shirts (Ababa et al., 2016). Here, how polluted the raw water resources through water footprint calculation from Kuantan river basin until the final step of filtration and the prediction of grey water footprint trend in the water treatment plants will be analysed.

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